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BARBERRY ERADICATION

for the Control

of

STEM RUST

of

Wheat, Oats, Barley and Rye

By C. C. Allison and Harry Atwood

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BARBERRY ERADICATION

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Stem Rust of Wheat, Oats, Barley, and Rye

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* * *

INTRODUCTION

For many centuries a tiny microscopic fungus, the cause of stem rust, has directly or indirectly affected the economy of nations by its effect upon the yield and quality of small grains. The exact cause of the disease was obscure until 1865 when it was shown through experimentation that the rust developed on and spread from certain species of barberry bushes to grains and grasses. Even before this time, the early settlers in America and citizens of other countries associated stem rust losses with barberry bushes and made local regulations prohibiting the growing of barberry bushes near grain fields.

Today, with a thorough knowledge of the stem rust fungus serving as a basis for the use of intelligent control measures, cereal crops can be grown without the risk of serious and widespread losses caused by this destructive disease.

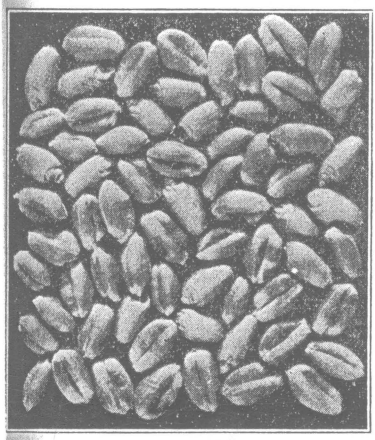

FIG. 1.—Plump, healthy grain

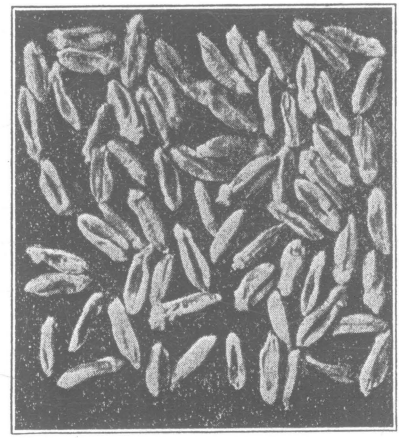

FIG. 2.—Shriveled, rusted grain

RUSTED FIELDS YIELD POOR QUALITY GRAIN

Losses from stem rust come after the principal costs of production have been incurred. Yields from fields damaged by stem rust are often reduced by 50 per cent or more, and the grain is shriveled, light in weight, and of poor quality for milling. Every grain farmer knows that severe stem rust infection can mean the difference between a profitable and an unprofitable crop.

Early records of the State Board of Agriculture show that stem rust was a limiting factor in wheat production in many parts of Ohio as early as 1846. In 1849 wheat yields were reported to have been reduced one-third by rust. In 1858 rust was responsible for a total failure of the oat crop.

The annual reports of the State Department of Agriculture from 1850 to 1903 show that rust occurred almost every year, with varying degrees of severity, in many widely separated sections in Ohio. From 1904 to 1915

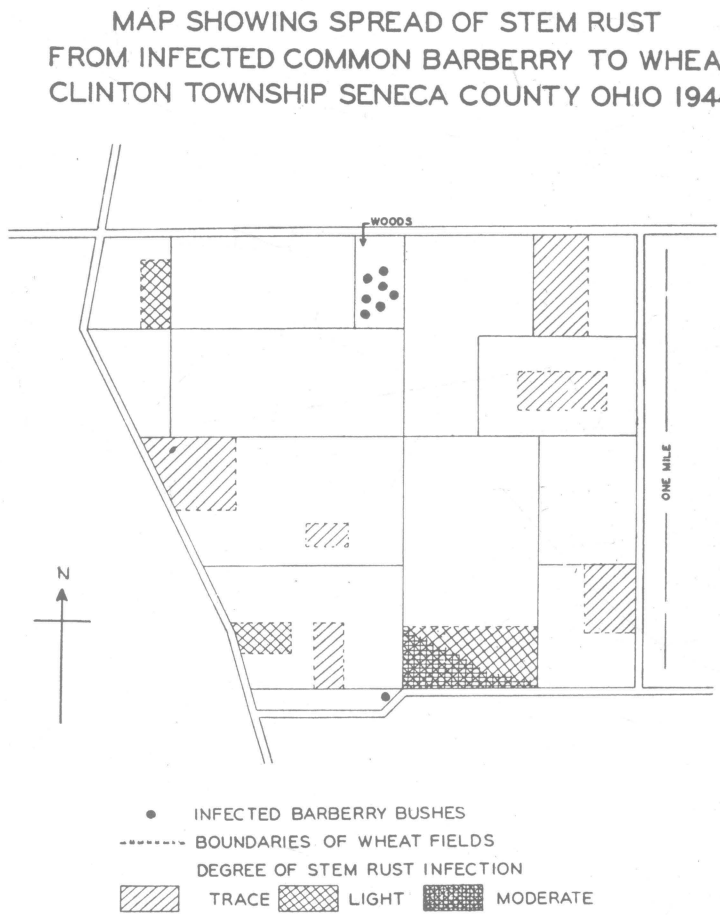

FIG. 3.—Showing the spread of stem rust from infected barberries to wheat

rust appeared regularly each year in greater or lesser amounts, the principal damage occurring in local areas. The serious losses in Ohio and other northern grain-producing states in 1916 led to the initiation in 1918 of a comprehensive control program of which Barberry Eradication was a part.

Observations made since 1918 show that losses from stem rust in Ohio usually result from local epidemics in the vicinity of barberry bushes. There are on file the history of many cases of rust spreading from barberry to grain which have been reported by farmers of the state. In some instances a study of local epidemics led to the discovery of barberry bushes that were the source of the rust.

During the 27 years in which Ohio has been cooperating with the United States Department of Agriculture in the Barberry Eradication program, there has been a gradual reduction in the damage caused by stem rust—an indication that the eradication of barberry bushes will eliminate the most important source of stem rust in this state.

LIFE HISTORY OF THE STEM RUST

The tiny parasitic fungus which causes stem rust of small grains lives for a time during the spring on the leaves of the common barberry and during the remainder of the growing season on the leaves and stems of wheat, oats, barley, rye, and certain native grasses. The disease is spread to host plants by wind-borne spores. Rust spores from diseased barberry leaves infect nearby wild grasses and grain plants, and the red or summer stage of the disease develops on these plants. Once this stage becomes established in the grain fields, the rust spreads by means of wind-blown spores from

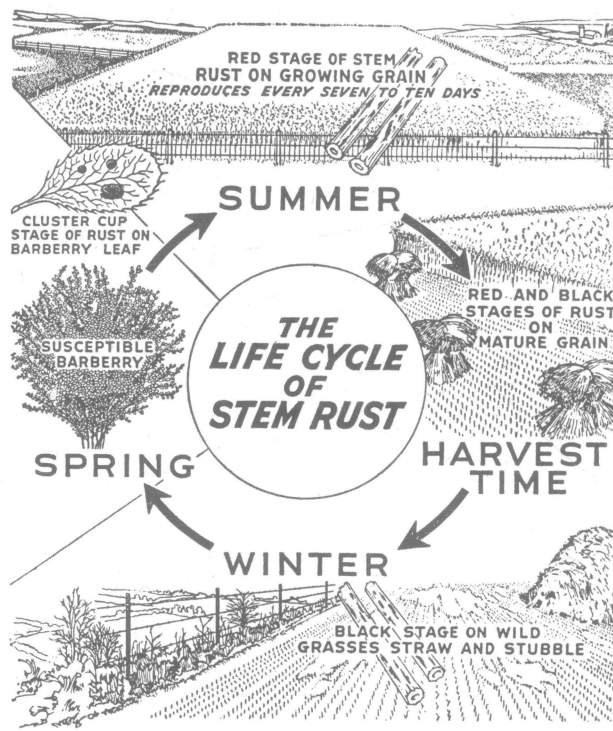

FIG. 4.—The annual cycle of stem rust

plant to plant and from grain field to grain field over extensive areas. When weather and crop conditions are favorable, these local epidemics merge and cause substantial regional crop damage.

As the crop ripens, black rust spores replace the red spores in the spots on the grain stems. In this stage the parasite remains dormant during the fall and winter months on wild grasses, old straw, and stubble. From this stage the fungus can develop only on the barberry the following spring. The destruction of the barberry eliminates the spring stage of the life cycle and thus prevents early local outbreaks of the disease in important grain-producing areas.

In the Central States there is another source of rust epidemics. Under favorable conditions the stem rust fungus overwinters in the red stage on grains and grasses in northern Mexico and Texas, where the winters are mild. This stage can develop directly on grains and grasses in the spring. Grain fields are almost continuous from Mexico to southern Canada.

In the South these crops mature early, and ripening is progressively later as the season advances northward. Some years, when moisture, temperature, and crop conditions are favorable, the red stage of the rust increases on the grain in the South, producing billions of spores. These spores are carried progressively northward by the wind and infect the developing grain. The spores produced on the newly infected grain are swept farther north by the wind, and in this manner the rust may build up into a major epidemic. Wind, moisture, temperature, and the condition of the grain must all be favorable at the right time to enable such epidemics to develop.

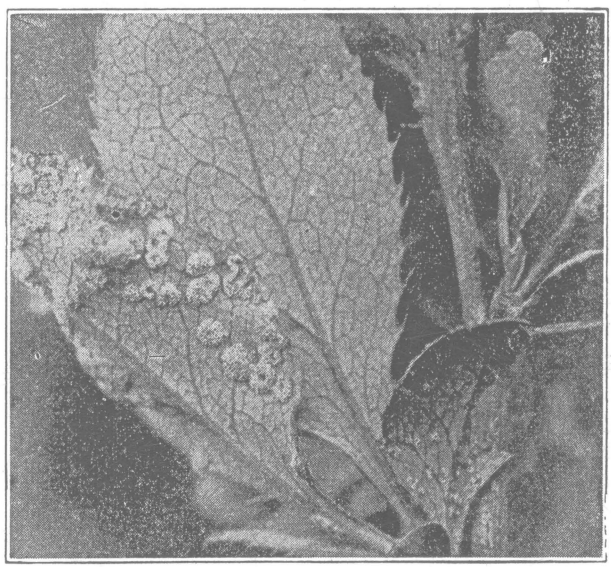

FIG. 5.—Stem rust on barberry leaves

Although it is possible for an epidemic to develop in Ohio from wind-borne rust spores from the southwest, losses caused by rust from this source have been of no consequence during the last 27 years.

NEW STRAINS OF RUST DEVELOP ON BARBERRY BUSHES

The eradication of rust-susceptible barberry bushes has another important value to grain producers and dependent industries. Just as there are many varieties of wheat, oats, barley, and rye, there likewise are many varieties and races of the stem rust fungus. Certain varieties of grain are highly resistant to some of these races but are very susceptible to others. New races are produced and old ones perpetuated through hybridization that occurs on the leaves of the barberry. Thus the eradication of the barberry reduces the opportunity for the fungus to develop races which might be capable of attacking new and improved rust-resistant varieties of grain.

There are 189 different races of the stem rust that attack wheat, 12 that attack oats, and 14 that attack rye. The existence of these races within the varieties of stem rust explains, to a great extent, why a given variety of grain may appear resistant to stem rust in some years and in some localities, and be severely attacked by stem rust in other years.

In the 17 years of investigation of the distribution of the stem rust races on wheat in Ohio, a total of 24 different races have been recognized. Only 10 were present over any considerable period. As long as rust-spreading barberry bushes exist in Ohio, new races of the stem rust fungus are likely to be produced.

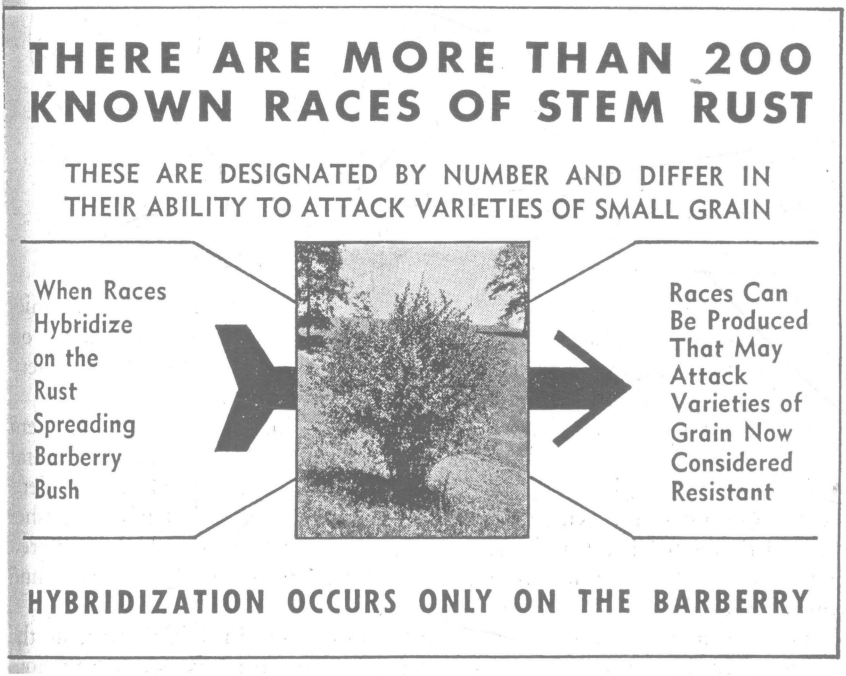

FIG. 6.—Hybridization occurs only on the barberry

LEARN TO KNOW THE RUST-SPREADING BARBERRY

The common or rust-susceptible barberry has a tall, erect habit of growth. The outer bark is gray, and the inner bark is yellow. The berries are borne in clusters like currants. The leaves have a saw-toothed edge. The thorns are usually in groups of three.

The harmless Japanese barberry has a low, graceful habit of growth and the bark is reddish-brown. The margins of the leaves are smooth. The flowers and berries are borne singly or in pairs. This and a few other species are immune to stem rust and thus can be grown without restriction.

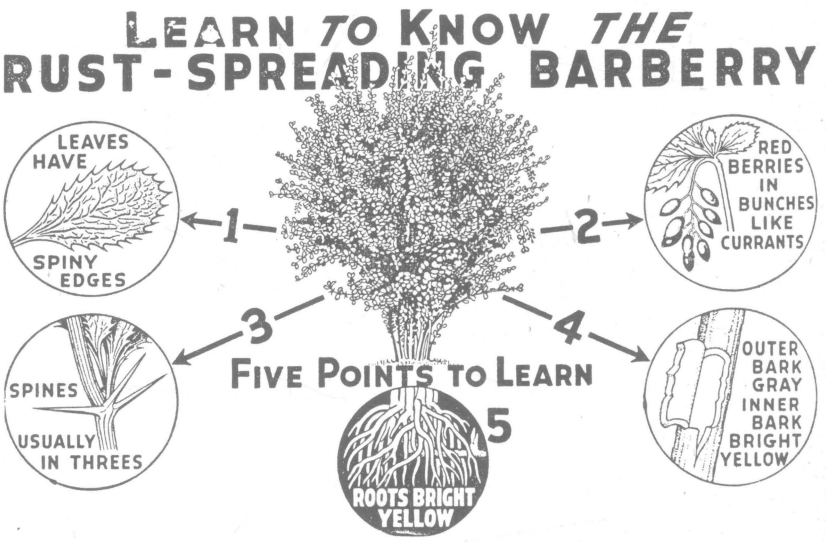

FIG. 7.—Identifying characteristics of the common barberry

PROGRESS IN CONTROLLING STEM RUST

Since 1918, when barberry eradication was first undertaken in Ohio, more than 3,271,000 rust-spreading barberry bushes have been destroyed on 17,005 different properties. Some control work has been conducted in every county in the state.

Rust-spreading barberries are not native in Ohio. Pioneers brought them from New England and other states and cultivated them as ornamental and hedge plants, and for the fruit. They were planted in yards and gardens in every Ohio county. Nurseries propagated rust-susceptible barberry bushes and sold them in large numbers. From these early plantings, birds scattered the seed far and wide with the result that barberry bushes have been found growing wild in 80 counties in the state.

Small grains are an extremely important crop in Ohio; and, at the beginning of the Barberry Eradication program, nurserymen throughout the state cooperated in the control work by discontinuing sale and voluntarily destroying all rust-susceptible bushes growing in their nurseries. Had

the barberry been permitted to grow unmolested, the increasing losses resulting from stem rust damage would have seriously jeopardized the production of small grains.

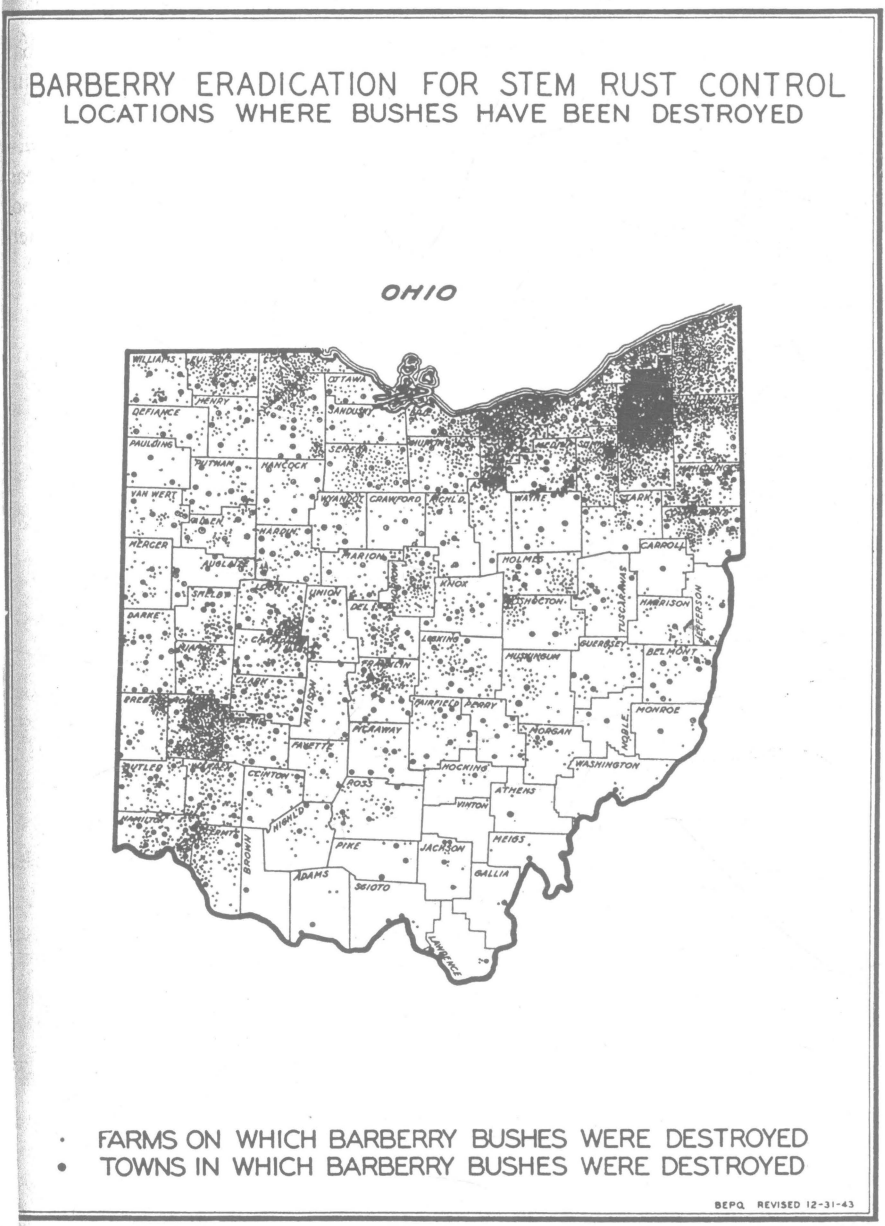

Fig. 8.—Progress in barberry eradication for control of stem rust—1918-1943

The control of stem rust is a problem of national as well as state importance. It involves the protection of the nation's basic food crops of wheat, oats, barley, and rye, and advantage should be taken of all available facilities contributing toward the prevention of losses from the disease.

Stem rust may be controlled in Ohio by:

1. *Barberry Eradication.*—The destruction of the rust-susceptible barberry will eliminate the early important source of stem rust in Ohio and reduce the chances for the production of races of the stem rust fungus.

2. *Growing only Approved Rust-resistant Varieties of Small Grain.*—Plant breeders have improved small-grain varieties by combining disease resistance with desirable agronomic characteristics, high yield, and good quality. Rust-resistant varieties that are recommended by the Experiment Station should be grown.

ERADICATION METHODS

Rust-susceptible barberry bushes can be destroyed by digging if care is taken to get out all the roots. The application of salt at the crown of each plant is the most satisfactory method and is the recommended procedure of eradication. From 12 to 15 pounds of salt will kill a bush in which the clump of stems is approximately 12 inches in diameter at the soil surface. More or less should be applied to larger or smaller bushes, with a minimum of 3 pounds. Common salt is effective in all seasons of the year and will kill all vegetation within a radius of 2 or 3 feet around the bush where it is applied.

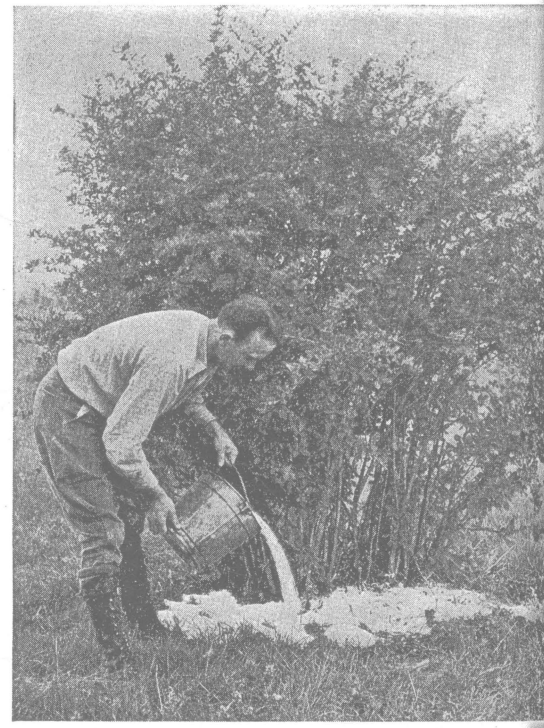

FIG. 9.—Destroying common barberry with salt

THE IMMEDIATE PROBLEM

There are 9,872 square miles of the state where the initial barberry eradication work has not been completed and where barberry bushes are

still growing. In addition, much work remains to be done in areas comprising 11,948 square miles where plants have been destroyed, and where there is now new growth that has come up from seed.

To protect the work already done, rework is given first consideration. Areas that were originally heavily infested must be rechecked periodically until there is no further danger of any new growth. Several inspections at intervals of from 5 to 7 years in many of these areas will be necessary to assure the complete elimination of the plant pest.

HOW TO DISTINGUISH BETWEEN STEM RUST AND LEAF RUST

In addition to stem rust, leaf rusts are commonly found on small grains. These may be distinguished in their summer stages. Only the stem rust and the leaf rusts of wheat and oats are of economic importance in Ohio.

Both rusts may be found on the grain plants during all stages of development, although the leaf rusts appear earlier in the growing season. Stem rust is characterized by elongated, irregular, reddish-brown spots found predominantly on the stems, although occasionally found also on the leaves, leaf sheaths, and heads. The leaf-rust spots are small and round. Leaf rust of wheat is orange and that of oats yellow-orange. The stem rust becomes most conspicuous as the grain ripens, while the leaf rusts are less noticeable at that time. Leaf rust has no connection with the rust-spreading barberry.

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SUMMARY

Stem rust of cereals in certain years has been the direct cause of reduced yields and poor quality of small grains in Ohio.

Rust-susceptible barberry is the important source of stem rust in this state. Although rust from overwintering centers in southern states may spread into Ohio, losses from this source have been of no consequence in this state during the last 27 years.

Stem rust is composed of many races, which are designated by number and differ in their ability to attack varieties of small grain. Races are produced by hybridization on the leaves of barberry bushes.

The eradication of barberry bushes not only eliminates local epidemics of stem rust, but also reduces the possibility for the production and perpetuation of races virulent to improved varieties of small grains now in commercial use.

In Ohio leaf rusts of wheat, oats, barley, and rye are present each year. Of these leaf rusts, only those of wheat and oats occasionally cause substantial damage. None of these leaf rusts are spread by barberry bushes.

THE OHIO STATE UNIVERSITY
Cooperating with
THE UNITED STATES DEPARTMENT
OF AGRICULTURE

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